JDB

Site: Syntex Verona
ID #: MOD007452154
Break: 7.8
General
Dioxin Materia

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Agency for Toxic Substances
and Disease Registry
Atlanta GA 30333

0757

July 30, 1987

Mr. David Wagoner
Director
Waste Management Division
EPA VII
Kansas City, Kansas 66101

40035354
SUPERFUND RECORDS

Dear Mr. Wagoner:

This letter is in response to your request for elaboration on the mathematics underlying the development of support for the 20 ppb cleanup level for certain Missouri dioxin sites as proposed in the letter from Mr. Morris Kay to Dr. Renate Kimbrough dated January 16, 1987. In Dr. Kimbrough's January 22, 1987 response she indicated that the proposed cleanup activities would restore the areas so that they would no longer be of concern for public health. In the enclosed memorandum from Dr. Vernon N. Houk, Director, Center for Environmental Health (CEH) dated May 8, 1987, the basic CEH guidance established for these sites was listed. In order to provide you with the assumptions and calculations underlying the CEH guidance I have included the following material from Dr. Kimbrough.

In 1984, Kimbrough et al., published a paper which examined the potential for exposure to TCDD in the environment. Since that time, new information has become available which appreciably alters the basic assumptions dealing with both the amount of soil young children ingest and the amount of absorption of TCDD from Missouri soil within the intestine. It now appears that the amount of soil ingested by small children is less than 10 grams and is more in the order of 100-2000 mg over a 24-hour period, (Binder et al., 1986). While Kimbrough et al., assumed that 30 percent of TCDD bound to ingested soil was bioavailable, subsequent tests with soil from different areas in Missouri have shown that 60 to 80 percent of TCDD may be absorbed following ingestion (McConnell et al., Science essentially n level in

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7-30-87 letter Re:
Underlying Devel. of 20 ppb

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However, the level of concern established by Kimbrough et al., as 1 ppb for residential areas has not changed because of these findings.

Based on the assumptions presented in the paper by Kimbrough et al., it can be concluded that soil in residential areas contaminated with 5 to 10 ppb of TCDD would not present a hazard if covered with 12 inches of clean soil. The rationale being that the clean surface soil would represent a barrier restricting human access to contact with the contaminated soil. In the event that the soil was disturbed, the 12 inches of clean soil would be mixed with contaminated soil and the concentration at the surface would, at most, reach 1 ppb. Thus, the risk in these areas, even after mixing of the subsurface contaminated soil with the clean cover soil would be comparable to that in other residential areas where the concentration of TCDD is 1 ppb or less at the surface. This approach would be acceptable in residential areas where the soil has not been physically disturbed by human activities.

Experience has shown, that concentrations decrease dramatically with depth in areas where the TCDD was applied to the surface. The 5 to 10 ppb/12-inch cover cleanup level would therefore be appropriate for sites like Castlewood, Times Beach, and Piazza Road. The 5 to 10 ppb would not be acceptable for residential areas where fill has been brought in from highly contaminated areas and where the levels of contamination may actually be inverted, resulting in increasing concentrations with depth.

The article of Kimbrough et al., focused primarily on residential exposure. However, the methods used to assess exposure in other situations were briefly discussed, (see pages 82-85). Basically the dose a person will receive depends on his or her activities and the ability of the TCDD to detach from the soil and enter the body. Thus, at sites which are not residential, the levels of concern may be different. For instance at a commercial site:

- Children would not play on a daily basis;
- It would be frequented by adults who would primarily walk through the area;
- It is unlikely that there would be any gardening; and
- There might be some short-term exposure during construction.

Thus, it is reasonable to assume that there would be little or no exposure. In a worst case scenario, dermal exposure of an adult to 1 gram of soil 5 times a week for 6 months per year could be assumed.

Although through ingestion of TCDD contaminated soil the amount of TCDD absorbed can be substantial, this is not true for skin absorption. As discussed in the paper by Kimbrough et al., (pp. 71-74), the most likely

amount that would be absorbed would be 1 percent or less of the TCDD on the soil. Thus, the dose received from one gram of soil containing 20 ppb (20 ng/gram of soil) on the skin would be 0.2 ng or 200 picograms (pg). The dose, on a kilogram body weight basis, would be 200 pg divided by 70 kg or roughly 3 pg/kg. However, since for these small concentrations the cumulative dose is more important than the daily doses, it must also be considered that the dosing is intermittent and not for a lifetime. Furthermore, the contamination of the area is not uniform and allowances would have to be made for the percent of contamination at different concentrations.

If only 10 percent of the area were contaminated at a concentration of 20 ppb then contact with contaminated soil would not be 100 percent but the corresponding fraction thereof (10 percent in this case). Thus, the daily dose if averaged out over a lifetime, taking the above assumptions of 5 days exposure for 6 months per year for 20 years as a basis, would result in an average daily dose of 330 femtograms/kg body weight. However, if only 10 percent of an area were contaminated at 20 ppb, then the dose would more likely be one-tenth of that or 33 femtograms/kg. Thus, such contamination with the exposure scenario outlined above would represent an acceptable risk based on the paper by Kimbrough et al., (1984).

It would not, however, be acceptable to leave higher levels of contaminated soil even with a cover of 12 inches. Leaving such soil with concentrations higher than 20 ppb could pose a threat to health and the general environment if the soil were disturbed in the future.

Kimbrough et al., (1984), stated that inhalation of TCDD bound on soil was negligible (pp. 71-72). Some work has recently been advanced that TCDD volatilizes to some extent from soil (Monsanto data, Schroy et al.). However this has not been substantiated by others (Yanders et al.), and only involves the surface area immediately above the soil but not the normal breathing zone of people. Furthermore, there is also re-absorbtion and slight movement into the lower layers of the soil. Particularly, such exposures would be even more unlikely in areas which have vegetation or where the surface is covered in some other fashion. In any case, volatilization of TCDD would not contribute to the overall exposure of people frequenting the area.

In summary, these proposed levels would not deviate from the general concept presented and developed in the paper by Kimbrough et al., (1984). When the paper was developed all available information on human health effects was taken into consideration. Since that time additional health studies have been performed. They have not provided any information which would suggest that TCDD is more toxic to humans than was assumed in 1984.

Recently, the information on human health effects was reviewed (Kimbrough, R.D., and Houk, V.N., Effects of Chlorinated Dibenzodioxin as Chapter 5 in Solving Hazardous Waste Problems, ACS Symposium Series 338. ACS Washington, D.C., 1987). Chloracne and some acute health effects have been found in highly exposed workers. However, there is no evidence that low level exposure such as that which might result from TCDD in soil at a concentration of 1 ppb would result in any acute or chronic clinical or subclinical effects.

Sincerely yours,

Barry L. Johnson

Barry L. Johnson, Ph.D.
Associate Administrator

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It has been established recently that TCDD bioavailability following ingestion of TCDD contaminated soil varies a great deal and depends on a variety of factors, such as:

- The concentration of TCDD in the soil;
- The length of time the TCDD was in contact with the soil; and
- The composition of the soil [Umbreit et al., Science 232:497499 (1986), and Umbreit et al., Society Toxicology meeting abstract 1273 (1986)].

However, the level of concern established by Kimbrough et al., as 1 ppb for residential areas has not changed because of these findings.

Based on the assumptions presented in the paper by Kimbrough et al., it can be concluded that soil in residential areas contaminated with 5 to 10 ppb of TCDD would not present a hazard if covered with 12 inches of clean soil. The rationale being that the clean surface soil would represent a barrier restricting human access to contact with the contaminated soil. In the event that the soil was disturbed, the 12 inches of clean soil would be mixed with contaminated soil and the concentration at the surface would, at most, reach 1 ppb. Thus, the risk in these areas, even after mixing of the subsurface contaminated soil with the clean cover soil would be comparable to that in other residential areas where the concentration of TCDD is 1 ppb or less at the surface. This approach would be acceptable in residential areas where the soil has not been physically disturbed by human activities.

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Sincerely yours,

Barry L. Johnson

Barry L. Johnson, Ph.D.
Associate Administrator

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service
Centers for Disease Control

Memorandum

Date · May 8, 1987

From Director
Center for Environmental Health

Subject Missouri Dioxin Sites Cleanup

To Barry L. Johnson, Ph.D.
Associate Administrator
Agency for Toxic Substances and Disease Registry

In response to your request regarding the subject sites, we offer the following information.

Based upon the information provided below, no further site sampling after remediation is necessary; however, continued surveillance of the area for erosion or disturbance in the paved areas will be necessary. In addition, if the use of the site changes, the previously done remedial action will have to be reevaluated at that time. This recommendation does not apply to any area that is to be used for agricultural purposes.

1. Residential sites: Where surface soil in residential areas exceeds one part per billion of 2,3,7,8-TCDD (hereinafter referred to generically as dioxin), removal of the surface soil to a level 1 foot is recommended. If at 1 foot deep, the residual dioxin is 5 to 10 parts per billion, then addition of clean soil to the original grade will be sufficient. In no case is it necessary to remove the soil to a depth of more than 4 feet, provided 4 feet of clean soil is added to reestablish the original grade.

2. Recreational sites: Recreational sites, such as riding areas, etc., should be cleaned to the same level as residential sites except that there should be at least 2 feet of clean soil above the soil containing 5-10 parts per billion.

3. Industrial sites: In Industrial sites in areas where worker contact to contaminated soil does not occur, it would be acceptable for the average dioxin levels up to 20 parts per billion remain in place. Areas exceeding 20 parts per billion would be evacuated until the residual concentration of less than 20 parts per billion is reached. Then the evacuated areas would be backfilled with appropriate noncontaminated material to the original grade. In no case would evacuation need to proceed beyond a depth of 4 feet.

   In certain areas where the area is paved, it is acceptable to leave surface concentration below the pavement of greater than 20 parts per billion under the paved surface. This would require continued monitoring for integrity of the paved surface where the average dioxin levels exceeding 20 parts per billion are left under the pavement.

I have attached correspondence from Mr. Morris Kay to Dr. Renate Kimbrough dated January 16 and from Dr. Kimbrough to Mr. Morris Kay dated January 22 on this same subject. We concur with the information contained therein.

In conclusion, if the contaminated sites are remediated and monitored as outlined in Mr. Kay's management plan, as expressed in his January 16 letter to Dr. Kimbrough, the sites would no longer represent a risk to human health and would no longer need to have surface level measurements for 2,3,7,8-TCDD performed. The reason is that the level at the surface with potential exposure to humans would be significantly below the 1 part per billion level, which is at present the level of concern. These areas would need to be visually inspected for erosion frequently, and if it occurs, action to prevent further erosion taken.

Vernon N. Houk, M.D.
Assistant Surgeon General

Attachments

cc:
Dr. John Bagby
Missouri Department of Health

TABLE 1
TCDD LIFETIME DOSAGE CALCULATION
OCCUPATIONAL EXPOSURE

PARAMETER	OCCUPATIONAL EXPOSURE WORST CASE ASSUMPTION
Years of exposure (Adult age 25-45)	20
Weight of worker	70 kilograms
Percentage of area at action level	10%
Frequency of contact (events per year) **	120
Average surface TCDD concentration	20 parts per billion (ppb)
Quantity of soil contacting skin per event	1 gram (g)
Quantity of TCDD contacting skin per event	0.00000002 g = 20 nanograms (ng)
Percentage TCDD absorbed into skin	1.0%
Quantity of TCDD absorbed per event	0.2 ng = 200 picograms (pg)

Dosage Calculation

Event dosage per kilogram body weight = 200 pg / 70 kg b.w. = 2.86 pg/kg b.w.

Number of lifetime exposure events = 120 events/year * 20 years * 10% area contaminated
= 240 events

Lifetime exposure = 240 events * 2.86 pg/kg b.w. = 686 pg/kg b.w.

Average lifetime daily exposure = 686 pg/kg b.w. / (70 years * 365 days)
= 0.0268 pg/kg b.w./day = 26.8 fg/kg b.w./day

Upper bound estimate*** for 10 E-6 incremental cancer risk = 1,400 fg/kg b.w./day

Lower bound estimate*** for 10 E-6 incremental cancer risk = 28 fg/kg b.w./day

Note: 1 nanogram (ng) = 10 E-9 gram
1 picogram (pg) = 10 E-12 gram
1 femptogram (fg) = 10 E-15 gram

** assumes 240 day work year, 50 percent restricted to indoors due to weather.

*** from "Health Implications of 2,3,7,8, Tetrachlorodibenzodioxin (TCDD) Contamination of Residential Soil", Kimbrough, R., et al., Center for Environmental Health, Centers for Disease Control, 1984.